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Looking for Liquidity: Banking and Emergency Liquidity Facilities

Lessons from the financial crisis, and developments since then, call for changes to the approach of Canadian authorities to crisis liquidity arrangements.

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The Study In Brief

As lender of last resort, the Bank of Canada has the responsibility of stepping in to provide liquidity in cases when markets require emergency funding. In crisis situations, a timely and effective response is imperative for avoiding systemic breakdowns. In this *Commentary*, I argue that in order to achieve this goal, a predefined, permanent, market-wide emergency liquidity mechanism should be established. The benefits of such a mechanism, including on-going design improvement and transparency for market participants, outweigh concerns over the moral hazard it may generate.

The financial crisis of 2008-09 led to a new set of reforms through the Basel III regulatory framework. These rules have provided stability, including by limiting risky behaviour by financial institutions. However, they have also created a significantly smaller market for liquidity. Therefore, in future times of stress, financial institutions will face increased difficulty obtaining funding from private markets. Furthermore, as technologies become more sophisticated, idiosyncratic shocks can propagate into systemic shocks faster than ever before.

Combined, these concerns suggest the need for pre-established, non-discretionary, market-wide emergency liquidity facilities that are instantly available in times of crisis. The permanence of such facilities would allow the design to be improved as market conditions evolve, while the removal of discretion would increase the level of transparency that is vital for a well-functioning financial sector.

While the design of the emergency liquidity features introduced by the Bank of Canada during the 2008-09 global economic crisis was appropriate, the auction format used likely fell short of generating the competitive prices and quantities that create both optimal liquidity distribution and the highest possible return for the public. In this paper, I recommend the use of the "Product-Mix" auction design, which involves an unlimited bid, single-round process in which bids are made on different forms of collateral simultaneously, and no minimum reference price above the benchmark overnight rate is established in advance. The Bank should continue to use discriminatory pricing for different term repos and uniform pricing for term loan facilities. Overall, these characteristics should improve the outcome of any future auctions from the viewpoint of both financial institutions and central bankers.

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In the wake of the Great Recession, it has become common to ask what policies should be in place to prevent any future financial stress from becoming a full-blown crisis.

Providing a liquidity and funding backstop is a key responsibility of the authorities as part of crisis preparedness. One lesson from the recent systemic stress on the financial system is that there should be no delay getting liquidity to market. Although a lack of liquidity might not be the cause of a given crisis, its loss in the aftermath of major negative shocks has severe and long-lasting consequences.

From the onset of the 2008 financial crisis, central banks across the developed world used different forms of extraordinary liquidity facilities, in many cases temporary, in an attempt to provide much-needed liquidity, stimulate credit markets and get the economy back on track. The scramble to provide liquidity demonstrated the need to establish market-wide, predefined emergency liquidity mechanisms to respond to any future financial crisis. Regrettably, although the Bank of Canada reserves the right to bring back the measures introduced during the crisis, this discretionary approach to policy makes it difficult from a transparency perspective to assess crisis preparedness, and impairs the ability to improve its ongoing design.

Since the crisis, bank regulations have changed, but the new policies are untested in crisis conditions. In addition, the federal government has adopted a different approach to its willingness to assume risk in the housing sector,[1] and has changed its approach to emergency liquidity backstops for major provincial institutions. Furthermore, a major concern regarding the next crisis is the speed with which a negative shock will be propagated to all financial institutions and to the economy as a whole. Without a clear understanding of when market-wide emergency liquidity measures will be available, financial institutions are left in the dark. Lessons from the crisis, and these developments since, call for changes to the approach of Canadian authorities to crisis liquidity arrangements.

At the detailed design level, any emergency mechanism should, as a first-order concern, ensure the central bank (or other facility provider) is helping to reestablish financial markets and financial market stability while not incurring unmanageable amounts of risk or compromising monetary policy objectives. A second-order issue would be the receipt of a competitive price for a given quantity of funding, which ought to generate the appropriate distribution of liquidity among bidders.[2]

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1 For example, by lowering the amount of new mortgages it insures from 90 percent during the financial crisis to approximately 50 percent today (Dmitrieva 2015).

2 In theory, the facility provider can be on either side of a typical transaction. In the standard auction, the provider sells a particular form (or many forms) of collateral for the expected market price. In a reverse auction "bidders compete to sell a diverse mix of securities" and facility providers pay the expected market price (Ausubel et al. 2011). While acknowledging the possibility of both, the focus in this *Commentary* is on the traditional standard auction format. I also use central banks as the primary facility providers.

The ideal emergency liquidity facility should (i) provide market-wide funding with no significant restrictions on potential financial institution bidders beyond what is laid out in the Bank of Canada's financial crisis facilities, (ii) give eligible institutions an unlimited number of bids, (iii) be done in a timely fashion with no preset minimum above the benchmark overnight rate, and (iv) be long-term backed by a variety of different forms of collateral. To address these issues, I argue that the "Product-Mix" auction design (see Klemperer 2010) should be used. With a lack of quantitative analysis available on the effects of uniform pricing, as Klemperer (2010) advocates, versus discriminatory pricing, the Bank of Canada should continue to use its discriminatory pricing approach for its term repurchase (term repo)[3] facilities and uniform pricing for its term loan facilities.

Lastly, in terms of restrictions, the federal government recently changed its policy so that major provincial credit unions will be able to access emergency liquidity only if the provincial government provides the Bank of Canada an open-ended indemnity. Several of these institutions are large enough to have systemic consequences in a crisis, and it is highly desirable that these arrangements be in place before any crisis hits. None of these arrangements are currently in place, however, so the federal authorities should provide more transparency on the liquidity arrangements these institutions would have access to in a crisis in order to encourage the provinces to sign on.

My overall recommendations, therefore, are as follows:

- the emergency liquidity facilities introduced during the financial crisis should be made permanent, rather than discretionary, and possible moral hazard problems should be dealt with through the design of the arrangements and other measures;
- the provinces and the Bank of Canada should actively discuss arrangements that would apply to major systemic provincial institutions in the event of a crisis, and enter into the necessary indemnity and loss-sharing arrangements as soon as possible;
- the authorities should undertake further studies as part of their financial stability responsibilities on how various severe liquidity and funding scenarios might be handled, taking account of the new regulatory rules for banks and the reduced availability of Canada Mortgage and Housing Corporation (CMHC)-related funding; and
- the liquidity auction format should be based on the "Product-Mix" design the United Kingdom uses for its Indexed Long-Term Repo, and until such time as a quantitative analysis on the effects of uniform versus discriminatory pricing is performed, the final sale price for term repos should continue to be based on a *discriminatory pricing* model, while term loan auctions should use *uniform pricing*.

Emergency Liquidity Facilities Worldwide

In determining if the Bank of Canada should have permanent, predefined, market-wide emergency liquidity facilities, it is important to understand what Canada did during the Great Recession – a topic I turn to in the next section.[4] It is equally as

3 Repos involve the sale of a particular security or set of securities and an agreement that the seller will buy them back at a future date.

4 As the focus is on central banks, I do not discuss other forms of effective lending to financial institutions that took place during the crisis. One significant example is the Insured Mortgage Purchase Program, whereby the federal government, through the CMHC, purchased National Housing Act Mortgage-Backed Securities, a form of bond that has a pool of guaranteed mortgage loans as its underlying asset. Financial institutions, in return, received cash payments in the hope that they would produce new loans for consumers and businesses (Nadeau 2009).

important to understand the types of emergency liquidity facilities introduced during the crisis in other countries, to see if they provide any lessons for Canada.[5] As it turns out, the specific facilities introduced in the United States and the United Kingdom, two countries in which the crisis was significantly more severe than in Canada, were very similar in design to those in Canada and addressed similar issues. Specifically, emergency liquidity mechanisms introduced by each of the three countries attempted to fix the drying up of longer-term lending; the abundance of highly illiquid assets; and the freezing up of markets responsible for continued lending to households and businesses.

Table 1 lists all the different facilities introduced by the three countries during the crisis, arranged by major issue being addressed. One additional deficiency arose in the United States – namely, that of having institutions that needed emergency liquidity yet were ineligible to access other facilities for one reason or another. To address this gap, the United States was forced to introduce specific facilities: the Term Securities Lending Facility and the Primary Dealer Credit Facility. Canada, on the other hand, faced no such problem. What is interesting about the comparison is that, even though Canada was able to escape the depths of the financial crisis, it still introduced many of the same facilities as the United States and the United Kingdom. This outlines the importance of having funding mechanisms that are well established and developed to react to current market conditions. It is also worth noting that, although Canada and the United States have wound down many of these emergency liquidity facilities and their future use is at the discretion of their central banks, the United Kingdom chose to keep many of its facilities in place – in effect, making the determination that the potential future benefits outweigh the potential moral hazard costs.

CANADIAN FACILITIES

The Bank of Canada has a set of permanent liquidity facilities that are part of normal day-to-day operations. These facilities mostly existed prior to the financial crisis, and are meant either to provide very short-term liquidity or to deal with liquidity strains at an individual institution, not in the market as a whole. Following a recent Bank of Canada consultation paper (Bank of Canada 2015b), Term Repos were added to the permanent set of facilities. Their purpose, however, is not emergency support for general market liquidity; instead, they are a tool the Bank uses to add assets to its balance sheet.[6]

When the financial crisis hit in 2008, it was clear that existing liquidity facilities were insufficient to allow the Bank of Canada to deal with growing market-wide concerns, since these facilities were only overnight in length or targeted to a specific financial institution. This is an important issue, as liquidity problems faced by only one institution will have different economic effects – and therefore will require different facilities – than systemic liquidity problems. In response, and similar to measures taken by the central banks in the United States and the United Kingdom, the Bank introduced

5 See Lavoie et al. (2011) for a complete summary of emergency liquidity facilities used in Canada and around the world. Plenderleith (2012) and Winters (2012) provide a comprehensive review for the United Kingdom. Board of Governors of the Federal Reserve System (2010) details these liquidity facilities for the United States.

6 Term Repos are for a maximum outstanding between $7 billion and $10 billion, a relatively small amount, and are available only to primary dealers in Government of Canada securities. They have terms typically of one to three months, although these may vary according to the Bank's discretion.

Table 1: Emergency Facilities and Underlying Liquidity-Related Issues, Canada, United States, United Kingdom

Major Issue for Facility	Canada	United States	United Kingdom
Injection of more longer-term liquidity	Term Purchase and Resale Agreement	Term Auction Facility	Term Auctions Extended Collateral Term Repo Indexed Long-Term Repo
Substituting less liquid for more liquid assets	Substitution of Non-mortgage Loan Portfolio for more marketable securities Term Loan Facility	Term Securities Lending Facility	Special Liquidity Scheme
Enhance functioning of markets responsible for lending	Term Purchase and Resale Agreement for private sector instruments	Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility Commercial Paper Funding Facility Money Market Investor Funding Facility Term Asset-Backed Securities Loan Facility	Asset Purchase Facility (Corporate Bonds) Funding Lending Scheme
Including institutions without access to traditional liquidity facilities	Not Applicable	Term Securities Lending Facility Primary Dealer Credit Facility	Not Applicable

Source: Author's compilation from Bank of Canada, Bank of England and Board of Governors of the Federal Reserve System.

many different forms of facilities to ensure a liquid financial market, to keep credit markets working and to remove any drying up of funding that would further slow the real economy.

Beginning in late 2007, the Bank attempted to increase the amount of longer-term liquidity available to the market by introducing the Term Purchase and Resale Agreement (PRA) Facility to provide liquidity to support the efficient functioning of financial markets. In April 2009, this facility was modified to reinforce the Bank's view of the future path of the overnight target rate.[7] Eligible

7 Term PRA announcements had both statistically and economically significant effects; see Enenajor, Sebastian, and Witmer (2010).

Table 2: Peak Emergency Liquidity Facility Usage, Canada

	Nominal Peak	Quarter It Occurred	Peak as Percent of Real GDP
	($ Billions)		
Term Purchase and Resale Agreement	37.00	2008/Q4	2.34
Term Purchase and Resale Agreement – Private Sector	3.26	2009/Q2	0.21
Term Purchase and Resale Agreement – Money Market	0.85	2009/Q1	0.06
Term Loan Facility	4.18	2008/Q4	0.26

Source: Author's compilation from Bank of Canada (liquidity facility usage), Statistics Canada (real GDP).

counterparties included primary dealers, who were the usual counterparties in repos, and a broad range of securities.[8] The Term PRA was by far the largest facility used during the crisis (see Table 2).

As the crisis continued, however, the mechanisms that supported the usual counterparties proved inadequate, as these recipients were unable or unwilling to lend to businesses and/or households. In response, the Bank of Canada first allowed institutions to substitute less liquid assets for more liquid ones. The Bank also allowed large value transfer system (LVTS) members a limited time in which they could exchange their non-mortgage loan portfolios for more marketable securities. These more marketable securities could then be used as collateral in funding markets. The Bank of Canada also introduced the Term Loan Facility, allowing direct participants in the LVTS to secure term loans against their non-mortgage loan portfolios.

Furthermore, as credit markets dried up, the Bank of Canada lent directly to institutions. It introduced the Term PRA Facility for private sector money market instruments, which in 2009 became simply the Term PRA Facility for private sector instruments. The goal of these facilities was to reinforce a liquidity backstop for large institutions operating in both the Canadian money market and corporate bond market that were regulated either federally or provincially and not eligible for the regular Term PRA – that is, to be eligible, they could not be Canadian primary dealers in Government of Canada securities or direct participants in the LVTS. A broad range of securities was eligible and subject to certain credit

8 Securities eligible for the Term PRA included those issued by the Government of Canada or provincial governments, bankers' acceptance and promissory notes, commercial paper and short municipal paper, asset-backed commercial paper that met the Bank of Canada's eligibility criteria and corporate and municipal bonds.

and other criteria. Non-primary dealers were able to participate indirectly, meaning they had to submit bids through a primary dealer.

By 2010, the Bank of Canada had wound down many of the extraordinary liquidity facilities put in place during the crisis and no longer in use. The Bank indicated, however, that it would reintroduce them at its discretion if financial sector stresses were sufficiently deep and broad. The Bank also reserves the right to allow access to the recently introduced *discretionary* Contingent Term Repo Facility, another longer-term emergency facility (Bank of Canada 2015b).[9]

Of the permanent, predefined, non-extraordinary facilities left in place, only Emergency Lending Assistance is not an overnight facility. However, as it is not a market-wide instrument, it cannot be expected to deal with a systemic crisis. Rather, it is a longer-term loan intended to address acute liquidity shocks at specific financial institutions that have credible recovery and resolution frameworks in place to deal with a liquidity and/or funding crisis.[10] Access to the facility is limited to federally incorporated deposit-taking institutions, provincial central credit unions and *caisses populaires* that are members of the Canadian Payments Association (Bank of Canada 2015a).[11] A broad range of assets is accepted under Emergency Lending Assistance, including non-mortgage loan portfolios and direct mortgage loans.

Next Steps

Because the extraordinary facilities introduced during the financial crisis were temporary, Canada still lacks the ability to address a future market-wide crisis quickly. The goal in times of stress should be to restore confidence in a timely fashion and as effectively as possible. The Bank of Canada has said that it reserves the right to relaunch the emergency facilities – including the Contingent Term Repo Facility – it introduced during the financial crisis if necessary (Bank of Canada 2015b). But since these facilities are discretionary, there is a continuing need for a more nuanced, ongoing discussion of their design, both internally at the Bank and externally. In the post-crisis era, as analysts and policymakers sort through the myriad new regulations and deal with a constantly evolving financial sector, these types of transparent discussions are vital for the well-functioning of the market.[12] Although the Bank might be operationally ready to bring back these extraordinary facilities at a moment's notice, it is not clear to financial institutions exactly when they would be able to access them in an environment of stress if they are not part of the toolkit on a day-to-day basis.

What is now required is a predefined mechanism to address the need for longer-term lending when liquidity is at a premium, to ensure firms are able to exchange less liquid assets for more liquid ones, to permit institutions to pledge an expanded amount

9 Under the Contingent Term Repo Facility, customizable terms for a maximum of one month are available. A range of counterparties can access this facility, and a broad set of securities can be used at a fixed price. The range of counterparties can be expanded beyond primary dealers if the Bank judges it necessary to support market stability, subject to conditions the Bank deems appropriate.

10 Technically, Emergency Lending Assistance could be structured, at the discretion of the Bank, as a rolling one-day loan over any length of time up to a maximum of six months.

11 Provincially regulated institutions also must have provincial indemnity against losses incurred by the Bank.

12 During the crisis, financial institutions became worried about counterparty credit risk and illiquidity in the repo market, which is a key funding market in the Canadian economy. To boost confidence in stressful times, in 2012 the Canadian Derivatives Clearing Corporation introduced a central counterparty service that acts as a buyer or seller on each transaction (including repos) to mitigate any future counterparty credit risk concerns; see Chatterjee, Embree, and Youngman (2012).

of collateral, to create an incentive for important players in the credit market to continue to lend to the real economy and to encompass all relevant financial institutions. Having more predefinition now would make clearer contingency planning possible, and could make it easier to specify conditions that would reduce gaming and moral hazard and ensure more appropriate pricing. From a qualitative standpoint, the features of the two forms of Term PRA, as well as the Term Loan Facility, are sufficient to address all these needs.

Costs and Solutions

The establishment of permanent, emergency, market-wide liquidity facilities would come with costs, of which the primary one is moral hazard. If banks and other financial institutions assume that, no matter the circumstance, they will always have liquidity support, they will have less incentive to be prudent in their liquidity behavior. This legitimate concern need not be a reason, however, for leaving future arrangements as undefined as they are now.

The details of arrangements matter a lot in attempting to mitigate the moral hazard issue. One option is to make liquidity support as unappealing as possible, such as by having banks pay a stiff fee. The exact nature of this cost could be flexible so that financial institutions would not be able to prejudge how they would be affected by accessing this form of liquidity. There would be some risk in charging a high fee, however, as it would stigmatize the usage of liquidity support, which might cause banks not to seek it out when they should (Rule 2013). On the other hand, it might be easier to set an appropriate fee now, rather than in the midst of a brewing crisis.

Another option comes directly from two of the Bank of Canada's five principles that guide extraordinary liquidity intervention – namely, that intervention should be commensurate with the severity of the problem and that the Bank should mitigate moral hazard of its actions through limited, selective intervention (Longworth 2010).[13] The solution then might be to set up the facility such that the market could access it only when certain negative financial metrics were met. The stigma associated with accessing the facility would still exist, but moral hazard should be somewhat negated. The key is to make these metrics clear.

In addition, now that banks' liquidity is explicitly regulated and banks have to provide acceptable (stressed) liquidity recovery and contingency plans, a range of other tools is available to ensure that banks do not skimp on liquidity just because the Bank of Canada becomes clearer on the emergency facilities that would be available in a crisis. One of these requirements, now in place, is that all domestic systemically important banks must report their liquidity coverage ratio as often as they publish financial statements. Furthermore, the Office of the Superintendent of Financial Institutions will assess the liquidity situations of all financial institutions that fall under the *Bank Act*, the *Trust and Loan Companies Act* and the *Cooperative Credit Association Act* using their liquidity coverage ratios, net stable funding ratios and net cumulative cash flows. These disclosure and supervisory tools make destructive risk taking difficult to undertake, and with the comprehensive rules set out in the global regulatory framework known as Basel III, the type of behavior that led to the 2008 financial crisis seems unlikely to repeat itself. Therefore, the types of negative

13 The other three such principles are that the measures should be targeted, well-designed, and efficient or non-distortionary.

shocks that could set off a crisis likely would not be due to poor liquidity-based decisions.[14]

Another common argument for leaving all market-wide emergency liquidity discretionary is that there is no reason a central bank should provide this type of funding in normal times when the market can provide it. But what do the new rules mean for liquidity in both the primary and secondary markets? When banks' liquidity coverage ratios are assessed, eligible assets include only high-quality liquid assets that are free of debt or any other form of financial liability. The idea behind such assets is that they can be turned easily into cash during times of stress. Again, this rule is meant to mitigate the types of behavior that can lead to systemic breakdowns. The downside of such a measure, however, is that the amount of liquidity in the global system, including in secondary markets, is much lower than it used to be. For example, in the United States, daily trading volumes of agency mortgage-backed securities fell from US$321 billion in 2010 to US$178 billion in 2014 (PwC 2015). This trend has direct implications for financial institutions, as it reduces their ability to access liquidity. Furthermore, this secondary market will only become more illiquid, as the private sector is unlikely to get heavily involved, especially with interest rates as low as they are and likely will remain. The implication, then, is that the banks' ability to transact in times of future financial stress will be lessened, so having an effective permanent, predefined mechanism in place has merit.

Moral hazard, in fact, might not be what drives the next crisis. The speed with which idiosyncratic negative financial shocks can become a systemic concern is much faster now than before the 2008 financial crisis. This is due in part to the increased efficiency of risk amplification, given the increased interconnectedness of institutions and activities on a global scale and the speed with which news travels. An example of this contagion from an idiosyncratic negative shock is a cyberattack that can cause a significant hit to a bank's balance sheet overnight, leading to a run on even a well-run bank and a massive hit to liquidity. Even if the cyberattack hit only one institution, the viral nature of news today could cause a crisis of confidence at other financial firms. Such a scenario underscores the need to have market-wide liquidity available instantaneously.

Without the ability to perform a quantitative cost-benefit analysis on predefined mechanisms, however, a judgment call is required. I argue that the benefits listed above outweigh the costs, especially given the possible tools to deal with moral hazard. In addition, a predefined, market-wide emergency liquidity mechanism would not remove all flexibility on the part of the Bank of Canada. The Bank could still introduce new facilities during a future crisis if those in place did not address all concerns, and in doing so it could continue to be guided by its five principles of liquidity intervention.

The Provincial Situation

It is important to touch briefly on the current situation for provincial institutions and what needs to be done from an emergency liquidity standpoint.

Provincial credit unions and *caisses populaires* can also be systemically important in a crisis. Certain provincial credit union centrals are also the liquidity providers for the whole of the credit union system, but they have limits on their capacity, and have no access to emergency liquidity support. The new

14 Furthermore, with the new bail-in system, eligible debt on banks' balance sheets will be written down and/or turned into equity. Although the focus of bail-in is capital, not liquidity, it should reduce moral hazard concerns at least partly.

federal policy is that these institutions will be able to access a liquidity facility of the Bank of Canada only if there is a provincial indemnity of any losses the Bank might incur. Understandably, the federal authorities do not want to write a blank cheque or make liquidity advances to institutions that are actually insolvent and need to be recapitalized or resolved. But getting these arrangements right would not be possible once a crisis has started, so the provinces and the Bank should put them in place now. It would be difficult, however, for a province to pass the necessary legislation in advance for a potentially unlimited indemnity, particularly if it does not know what liquidity support from the Bank would actually be in place.

Other Developments

Three other developments post-crisis deserve noting. First, the federal government has evidenced less willingness by the CMHC to enter into arrangements to insure mortgages or provide insurance for mortgage funding vehicles – as noted earlier, the CMHC is now insuring only 50 percent of new residential mortgages, down from approximately 90 percent during the financial crisis (Dmitrieva 2015). This could significantly impede that avenue for institutions to obtain liquidity and funding support in a crisis. Second, specific regulations have been introduced to govern the required liquidity positions of banks, and institutions' positions relative to the minimum regulatory ratios must be published quarterly, but market pressure for more frequent publication might arise in a crisis. Third, as part of recovery and resolution planning, institutions must have acceptable plans, and must issue a significant amount of debt in their capital structure that authorities can decide to convert to equity in a crisis. These developments mean that institutions and market participants might act very differently in a future crisis than they did in the last one, and the speed with which developments occur might be accelerated. That would have implications for emergency liquidity arrangements that need to be thought through now, not left to when another severe stress occurs. One way to do so is through scenario planning.

How to Auction/Price a Predefined Mechanism

Given the need for a market-wide permanent emergency liquidity mechanism, one key issue is how it should be priced. As part of this determination, it is useful to review how extraordinary facilities have been priced in Canada.[15] (For a summary of what the United States and the United Kingdom have done, see Appendix A.) By analyzing the costs and benefits, one can determine a set of characteristics that makes up an ideal auction design.

First, however, it is worth discussing an alternative to an auction – specifically, a posted-price full allotment as used by the European Central Bank during the 2008 crisis. In this liquidity distribution mechanism, a fixed price is set, generally at the policy rate, and the total amount of demand at this price is supplied. From an efficiency standpoint – meaning how much banks' liquidity is traded away from the policy rate – there are clear gains under this system (see Ollikka and Tukiainen 2013). Everything is preannounced, financial institutions are able to prejudge the

15 At time of writing, terms and conditions for the auctioning of the Contingent Term Repo Facility have not been made clear. I therefore do not consider its pricing here. I also do not discuss the auction mechanism for Term Repos, as they are not intended for liquidity purposes.

amount they will have to pay and market rates remain in line with the policy rate. Such a system has costs, however. First, no price information is gained from bidding, which is fixed in advance. Second, if bidding becomes detached from reality, which might occur as allotment depends on how much banks determine they need, the usefulness of the information that comes from these liquidity distributions could lead to ineffective monetary policy. Third, additional liquidity in the system, beyond what is optimal, is directed based on the desires of financial institutions, potentially in areas that are not in the public's best interest (see Kaminska 2011). Therefore, although posted-price full allotment is an option for liquidity distribution, I argue that the auction mechanism is preferable.

Canadian Auctions

For Canada's three different Term PRA facilities, a multiple-yield auction was used. This auction was a single-round event, meaning all funding was distributed simultaneously, with either two or three maximum bids allowed. Minimum bids, in terms of value, were put in place for each, and in both the Term PRA for private sector money market instruments and its successor the Term PRA for private instruments, minimum rates above the target overnight rate were established and announced before the auction. In all three cases, winning bids were awarded by descending order of yield – that is, discriminatory pricing. Specifically, the highest bid was accepted and the yield-bid paid, and this continued until the total funds intended for allocation were sold. In terms of collateral, bidders specified after the auction the type of collateral they were pledging.

A few issues arise with this form of auction. First, there is the distortion of optimal pricing and distribution of ideal liquidity, which occurs when the amount of bids is restricted, thereby limiting the ability of bidders to create complete demand functions. This distortion on the demand side prevents the true competitive equilibrium price and quantity from being established for the different forms of collateral within the auction. Furthermore, by setting a minimum rate above the target overnight rate, the Bank of Canada runs the risk of mispricing and, in any event, restricts the creation of its own complete supply curve, exacerbating the inefficiencies seen on the demand side. Therefore, to create a competitive equilibrium for a given collateral, ideally there should be unlimited bidding and no minimum rates that sit above the overnight target rate.

It is important to explain why minimums above the benchmark overnight rate exist in the first place. First, they work as a penalty and help to mitigate moral hazard. Second, if atypical repo borrowers are allowed access to these facilities, they should be forced to pay more than normal primary dealers do. On the first point, however, if a stiff fee is set for accessing the facility in the first place, any additional penalty is redundant. On the second point, if atypical borrowers are allowed in, a scenario is created in which there will be excess demand at the minimum rate in any case, which will push up the price for this facility and generate a higher cutoff rate. If discriminatory pricing is allowed, therefore, it likely will end up with a required paid price above the minimum benchmark rate.

Canada's Term Loan Facility auction was also undertaken in a single round and allowed only two bids. It, too, had a minimum bid value and a rate established before the auction. In that sense, it suffered from the same inefficiency issues as the Term PRA facilities. Furthermore, the way bids were accepted or rejected was determined by the minimum accepted yield determined by the auctioneer. Funds were allocated at bids at or above this minimum, with all winning bids per participant combined into a single transaction paying the same price – that is, uniform pricing. In the case of general term loans, as opposed to term repos, it makes sense to have uniform pricing, since part of the reason to have loan auctions is to avoid the stigma associated with Emergency Lending Assistance. Since financial institutions

can always access such assistance – meaning they almost always pay the overnight rate – it is not clear why they would participate in the auction if they ran the risk of having to pay above the overnight minimum rate. As long as those who can participate in the Term Loan Facility can also participate in Emergency Lending Assistance, uniform pricing is the appropriate mechanism.

It is clear that, although they have some appropriate features, the auctions Canada has used to provide liquidity to the market could be improved (Table 3 summarizes the features of the Bank of Canada's different liquidity facilities' auctions). Current Bank auctions likely will not maximize efficiency in terms of creating a competitive equilibrium on prices and quantities for bidders and sellers leading to optimal liquidity distribution, and will therefore not maximize central banking value.

The Ideal Design

In the United Kingdom, the Indexed Long-Term Repo was auctioned using the "Product-Mix" design (Klemperer 2010). In this design, the seller, the Bank of England, auctions different forms of collateral with a differing range of associated risks, and the per-unit price of these forms of collateral is the interest rate. All bidders, consisting of various financial institutions, may make an unlimited number of bids. Each bid must include an offer of a per-unit price for each variety of collateral. So, for example, one bid might be for $500 million at 5.5 percent for the strongest collateral, at 5.8 percent for a weaker collateral, and at 6.0 percent for the weakest collateral. Each offer can be thought of as being mutually exclusive. These unlimited bids for different forms of collateral allow bidders to create a complete demand function. They also create a situation in which, in theory, they choose how much to buy after seeing the prices, leading to less error on the part of bidders or their paying too much for a particular variety of collateral – the so-called winner's curse. It should also allow bidders to better organize their liquidity and risk of their portfolios.

Once all bids have been sent in, the auctioneer then analyzes them to establish a minimum cut-off price for each variety of collateral. The auctioneer is able to analyze demand before choosing prices, which, similar to bidders' submitting bids at different price levels, reduces inefficiencies. In making the determination for cut-off prices, the auctioneer needs to consider the Bank of Canada's primary concern. In many cases, it will be to inject a certain level of liquidity into the system. If total liquidity is the primary concern, then the cut-off yields, taken in their entirety, will have to create this amount of funding for the market.

At this point, the auctioneer is to accept all bids for a given variety of collateral that are above the minimum cut-off price. However, the auctioneer can accept only one offer from each bid. So, in the example above, only one collateral and price combination is used for the $500 million bid. If more than one offer happens to be above the respective minimum cut-off price, the Bank of Canada will take the bid that maximizes the bidder's surplus, which can be measured as the distance between the minimum price for each variety and the bid offer. The last step is payment: for each accepted offer that exceeds the minimum price, the bidder will pay this minimum for the particular form of collateral. In other words, there is uniform pricing.[16]

16 Note that the current version of the Bank of England's "Product-Mix" auction design uses a more endogenous total quantity, whereby the amount of money the Bank of England puts out in the market varies based on the bidding of financial institutions. Also increased dimensions are used to determine the different qualities of collateral.

Table 3: Characteristics of Facilities Using Auctions, Canada

	Unlimited Bids	No Minimum Bid/Rate[a]	Single Round	Simultaneous Bidding[b]	Multiple Collateral[c]
Term Purchase and Resale Agreement	no	no	yes	yes	yes
Term Purchase and Resale Agreement – Private Sector	no	no	yes	yes	yes
Term Purchase and Resale Agreement – Money Market	no	no	yes	yes	yes
Term Loan Facility	no	no	yes	yes	no

Notes:
a Answering "no" to No Minimum Rate means a minimum above the benchmark rate was set by the central bank.
b Different forms of collateral can be used in bids.
c Must allow for different final sale price for each form of collateral.

Source: Author's compilation from Bank of Canada.

One area of debate surrounds uniform versus discriminatory pricing. One argument for discriminatory pricing is that, if the goal of the auction is to get an honest valuation from bidders, discriminatory-price models are more likely to produce this result, since, in the uniform-price model, bidders tend to use steeper bid curves than their true valuations support. Furthermore, in both theory and practice, collusion tends to be reduced in discriminatory pricing (see Monostori 2014). The argument for uniform pricing, however, is that, since discriminatory-pricing bidders know they will pay the full bid amount, they will bid less than their true valuations so as to be better off when they win. These lower bids imply that bidders are creating much flatter bid curves than their true valuations. Maximization of central banking revenue, therefore, will not be realized. By contrast, in a uniform-price auction, if there is a reasonable number of bidders, bids will be full valuation because financial institutions are aware that the values they bid almost certainly will affect only whether they win or lose, and will have no effect on the price they pay if they win. The argument then is that, with discriminatory pricing, the effect of steeper bid curves is dwarfed by the effect of flatter curves, while the loss from uniform pricing is offset by aggressive bidding. Furthermore, because of difficulties in determining how to bid, discriminatory pricing discourages bids from financial institutions in times of crisis.

Overall, in the absence of a quantitative analysis, the conservative approach would be for Canada to stick with what was done during the 2008 financial crisis, and use discriminatory pricing in the repo cases and uniform pricing in the loans cases. The latter is assuredly the appropriate format given the earlier discussion on the design of the Term Loan Facility and Emergency Lending Assistance. Therefore, using the "Product-Mix" design as a

Table 4: Characteristics of Facilities Using Auctions, United States

	Unlimited Bids	No Minimum Bid/Rate	Single Round	Simultaneous Bidding	Multiple Collateral
Term Auction Facility	no	no	yes	yes	no
Term Securities Lending Facility	no	no	yes	no	yes

Source: Author's compilation from Board of Governors of the Federal Reserve System.

Table 5: Characteristics of Facilities Using Auctions, United Kingdom

	Unlimited Bids	No Minimum Bid/Rate	Single Round	Simultaneous Bidding	Multiple Collateral
Term Auctions	no	no	yes	yes	yes
Extended Collateral Term Repo[a]	no	no	yes	yes	yes
Indexed Long-Term Repo[b]	yes	yes	yes	yes	yes
Asset Purchase Facility	no	no	yes	yes	yes

Notes:
a Became Contingent Term Repo Facility.
b Formerly Extended Collateral Long-Term Repo.

Source: Author's compilation from Bank of England.

template, with the uniform versus discriminatory pricing adjustment, a set of five ideal auction characteristics emerges. Specifically, the benefits of this method include single-round auctions that generate complete demand-and-supply functions through unlimited bidding and by not announcing any form of reference or minimum price above the benchmark rate. Furthermore, all collateral would be sold simultaneously with individualized pricing, and bidding would be allowed for different collateral within the same bid (Table 3 above and Tables 4 and 5 show how the different facilities score on these characteristics in Canada, the United States and the United Kingdom).

CONCLUSION

In this *Commentary*, I have argued that the benefits of having a predefined, permanent, market-wide emergency liquidity mechanism outweigh concerns

about moral hazard. Reforms introduced through the Basel III regulatory framework have made it much more difficult for financial institutions to engage in risky behaviour, and the market for liquidity is much smaller than it was. Furthermore, since the propagation of idiosyncratic shocks into systemic shocks can occur at a moment's notice, there is a need to have non-discretionary market-wide emergency liquidity available instantaneously, and its effectiveness would be vastly improved if it were well-established. The permanence of such facilities would improve the ability of the Bank of Canada to ameliorate their design as financial conditions evolve. Furthermore, the Bank's current discretion with respect to emergency liquidity diminishes the transparency needed to ensure a well-functioning financial sector, so predefined, permanent facilities would improve the Bank's credibility.

The extraordinary facilities the Bank of Canada introduced during the financial crisis were sufficient to meet the needs of Canadian financial institutions from a design standpoint. However, the format used to auction these market-wide facilities to bidding financial institutions likely did not create the competitive prices and quantities needed for the central bank to generate both the highest possible return and put liquidity in the hands of the appropriate financial institutions. Accordingly, I suggest using the "Product-Mix" auction design, which generates complete demand-and-supply schedules in an unlimited bid, single-round process in which bids are made on different forms of collateral simultaneously, and no minimum reference price above the benchmark overnight rate is established in advance. In the absence of quantitative analysis on discriminatory pricing versus uniform pricing, I recommend sticking with the approach the Bank used during the financial crisis – namely, discriminatory pricing for the different term repos and uniform pricing for term loan facilities. Overall, these characteristics should lead to an optimal auction design for both financial institutions (bidders) and central bankers (or other facility providers).

APPENDIX A:

US Auctions

Even though the United States has introduced many different forms of temporary emergency liquidity facilities with market-wide goals, only two were auctioned, the Term Securities Lending Facility and the Term Auction Facility. The auction of the Term Securities Lending Facility was really two different auctions for the different forms of collateral. It had a maximum of two bids and a minimum bid value, and each auction was uniform priced at the minimum accepted yield set at the top end of the federal funds rate target (see Board of Governors of the Federal Reserve System 2010). However, optimal liquidity distribution does not occur as complete demand-and-supply functions cannot be established when only two bids are allowed and a minimum bid value is set in advance. Although there was the additional benefit of different prices used for different forms of collateral, there was also an additional concern that more resources were used to get liquidity to market, since the auctions were undertaken separately.

The Term Auction Facility auction, which allowed a maximum of two bids, was a single-round auction in which, even though different forms of collateral were used to bid, a uniform price was paid regardless of the collateral. Further, the price was the minimum of the accepted bids set at the top end of the federal funds rate target. A minimum bid amount was also established *ex ante*.[17] Therefore, problems similar to those of the Term Securities Lending Facility auction emerge and, in addition, paying the same price for different forms of collateral is inefficient and unrepresentative of a true competitive equilibrium.

UK Auctions

In the United Kingdom, auctions were not used for either the Standing Liquidity Facility or the Funding for Lending Scheme, but were used for other facilities. In the case of term auctions, both a maximum amount of five bids and minimum rates above the benchmark rate were used, making complete demand-and-supply curves for bidders and sellers impossible. The Asset Purchase Facility and the Extended Collateral Term Repo also set maximum bids, minimum rates above the benchmark rate and minimum bid amounts, creating the same inefficiencies. For the Indexed Long-Term Repo, the "Product-Mix" auction mechanism was used. As described in the main text, this auction format contained the most positive features for future optimal design in Canada.

17 See Board of Governors of the Federal Reserve System, "Term Auction Facility Questions and Answers," available online at https://www.federalreserve.gov/monetarypolicy/taffaq.htm.

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